FIG.1

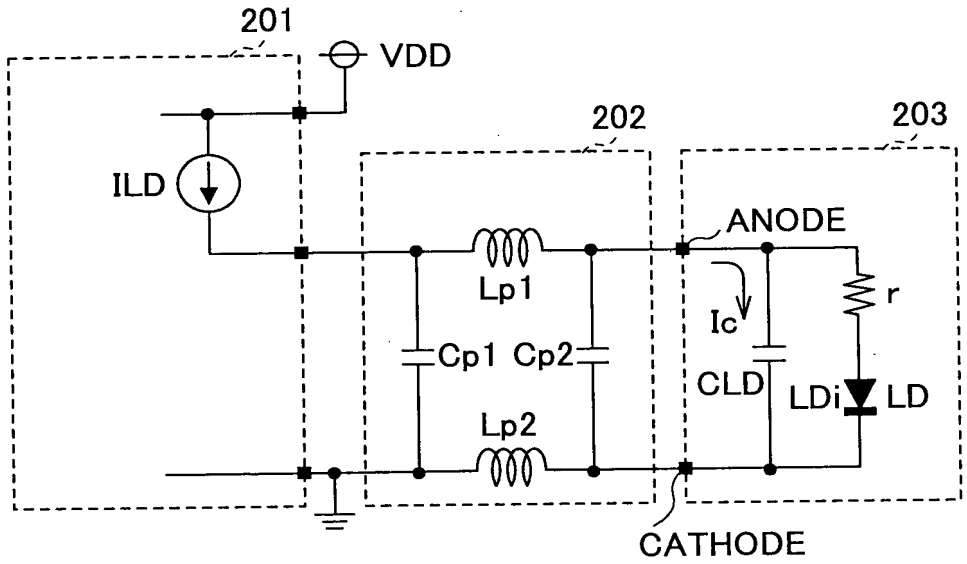


FIG.2A

FIG.2B

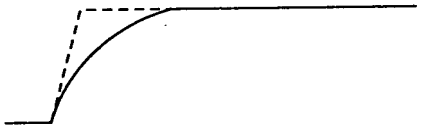


FIG.2C

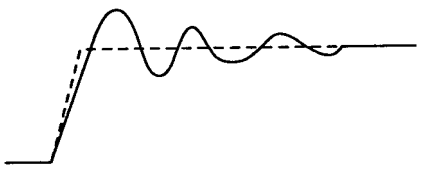
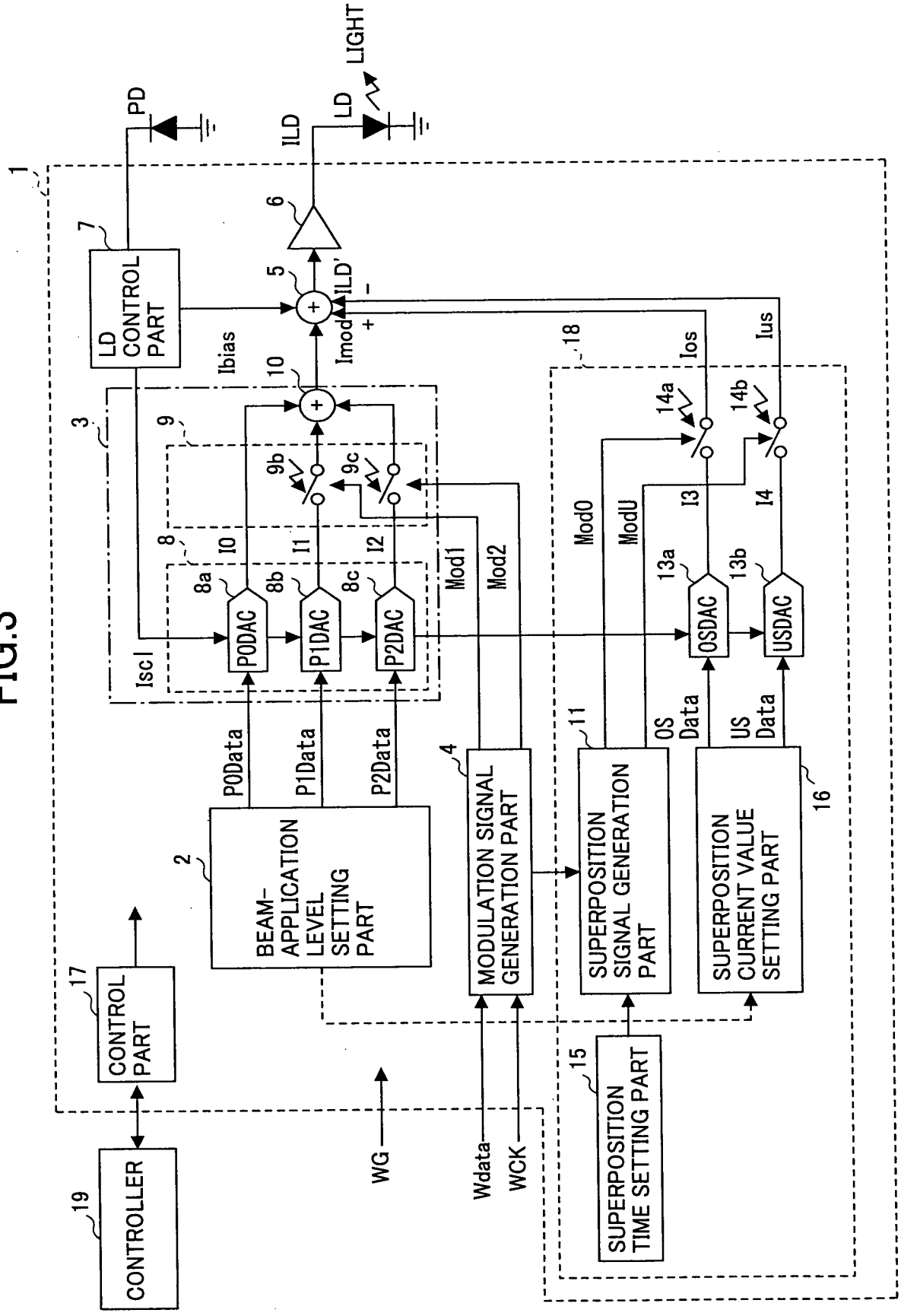


FIG.3


1
PD
LIGHT
ILD
LD
6
7
LD CONTROL PART
5
ILD'
Imod
Ibias
10
3
9
9b
9c
8
I0
I1
I2
8a
8b
8c
P0DAC
P1DAC
P2DAC
Isc
Mod1
Mod2
18
Ios
Ius
14a
14b
Mod0
ModU
I3
I4
13a
13b
OSDAC
USDAC
P0Data
P1Data
P2Data
OS Data
US Data
2
BEAM-APPLICATION LEVEL SETTING PART
4
MODULATION SIGNAL GENERATION PART
11
SUPERPOSITION SIGNAL GENERATION PART
SUPERPOSITION CURRENT VALUE SETTING PART
16
17
CONTROL PART
15
SUPERPOSITION TIME SETTING PART
WG
Wdata
WCK
19
CONTROLLER

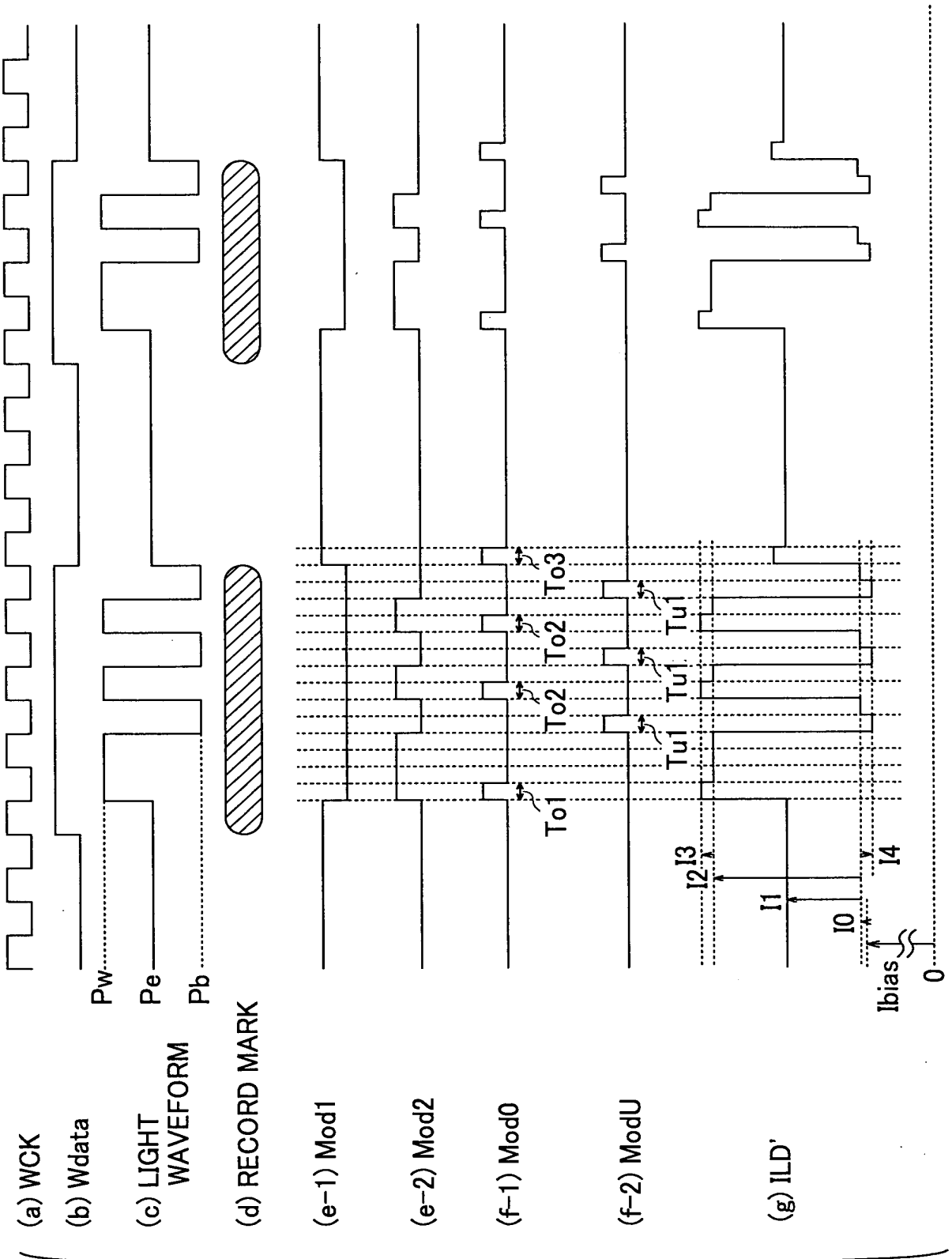

(a) WCK
(b) Wdata
(c) LIGHT WAVEFORM
(d) RECORD MARK
(e-1) Mod1
(e-2) Mod2
(f-1) Mod0
(f-2) ModU
(g) ILD'
Pw
Pe
Pb
To1
To2
To2
To3
Tu1
Tu1
Tu1
I2
I3
I1
I0
I4
Ibias
0

FIG.4

FIG.5

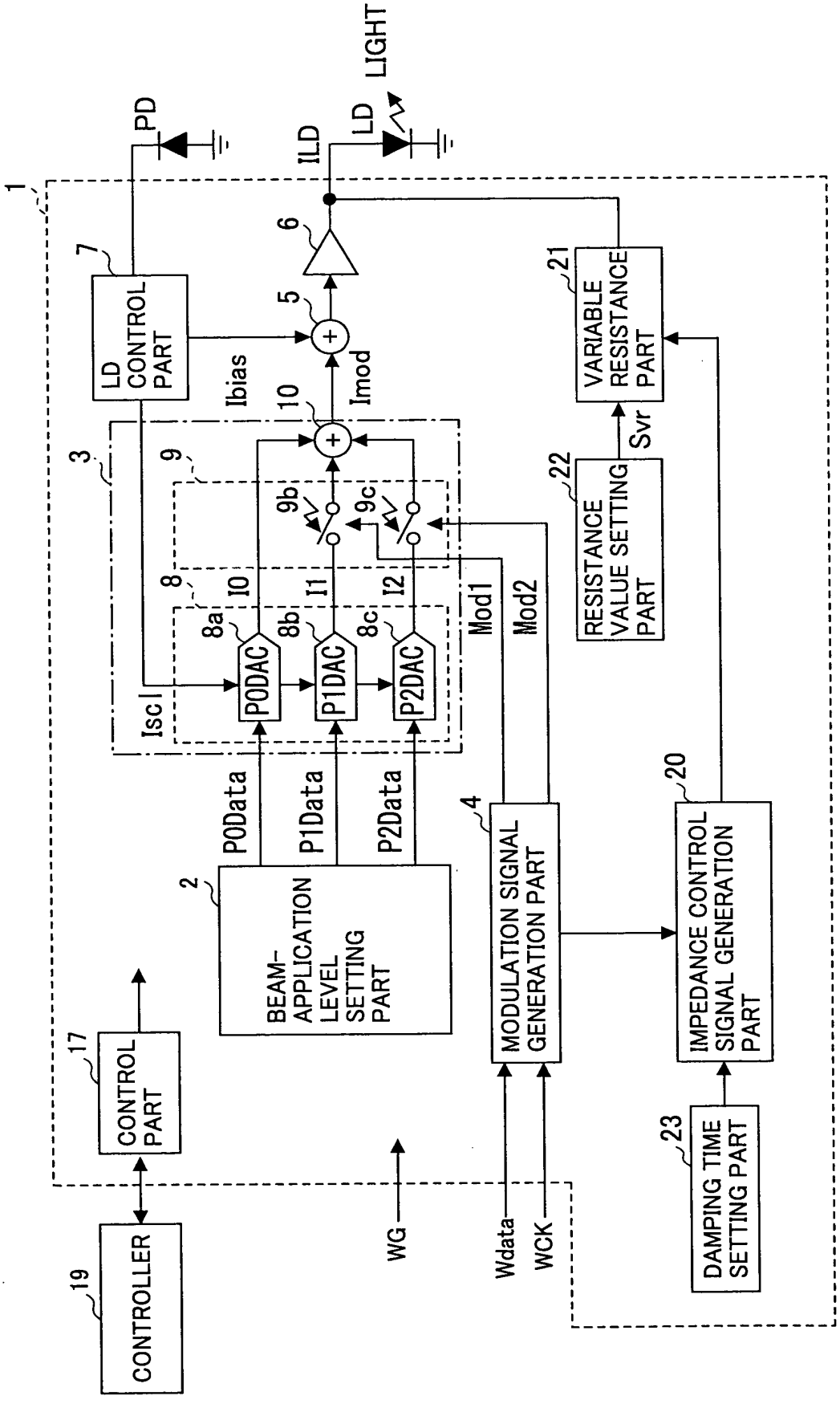

LIGHT
PD
ILD
LD
1
6
7
21
LD CONTROL PART
VARIABLE RESISTANCE PART
5
Ibias
Imod
10
Svr
3
9
22
9b
9c
RESISTANCE VALUE SETTING PART
8
I0
I1
I2
Mod1
Mod2
8a
8b
8c
P0DAC
P1DAC
P2DAC
Isc
P0Data
P1Data
P2Data
20
4
2
BEAM-APPLICATION LEVEL SETTING PART
MODULATION SIGNAL GENERATION PART
IMPEDANCE CONTROL SIGNAL GENERATION PART
17
CONTROL PART
23
DAMPING TIME SETTING PART
WG
Wdata
WCK
19
CONTROLLER

FIG.6

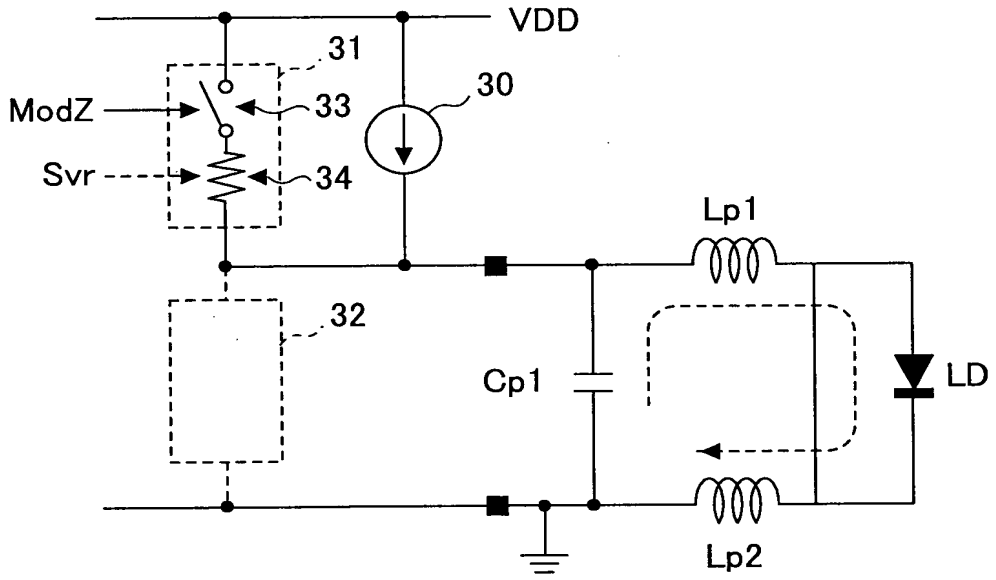

VDD
31
30
ModZ
33
Svr
34
Lp1
32
Cp1
LD
Lp2

FIG.7

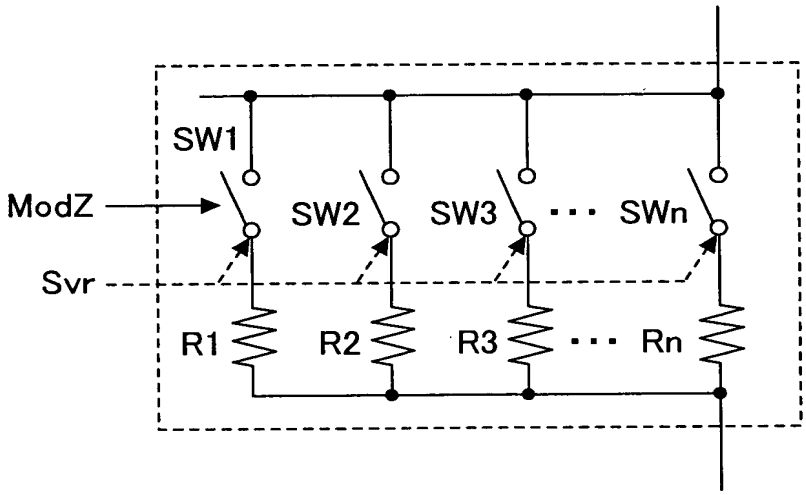

SW1
ModZ
SW2
SW3
SWn
Svr
R1
R2
R3
Rn

FIG.8A

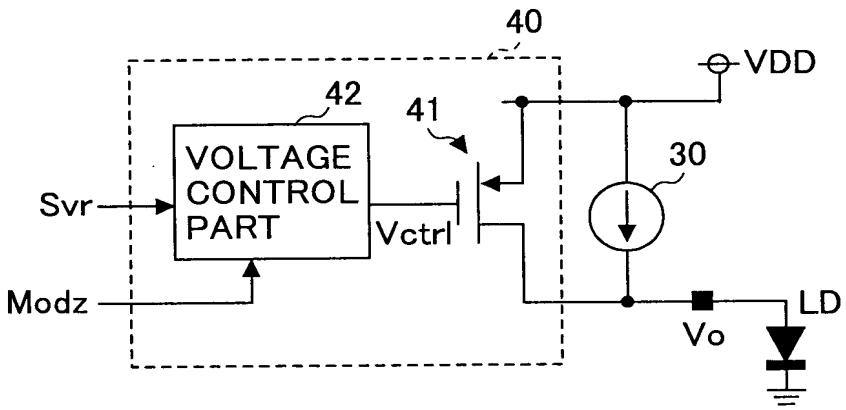


FIG.8B

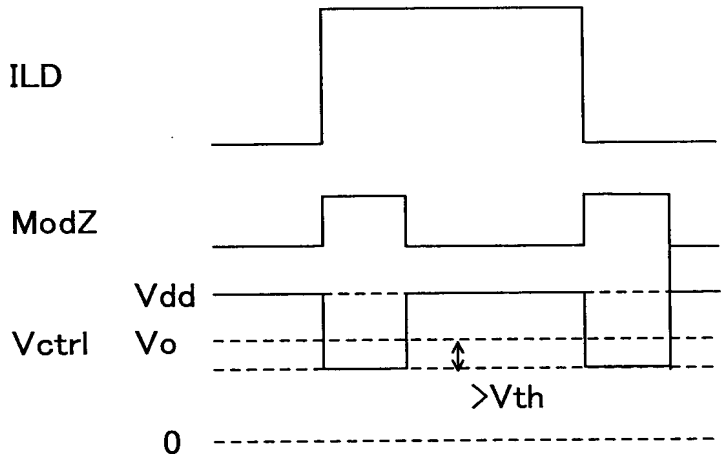


FIG.8C

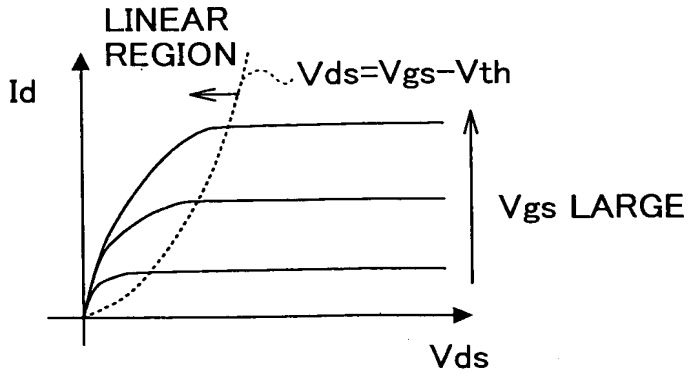


FIG.9

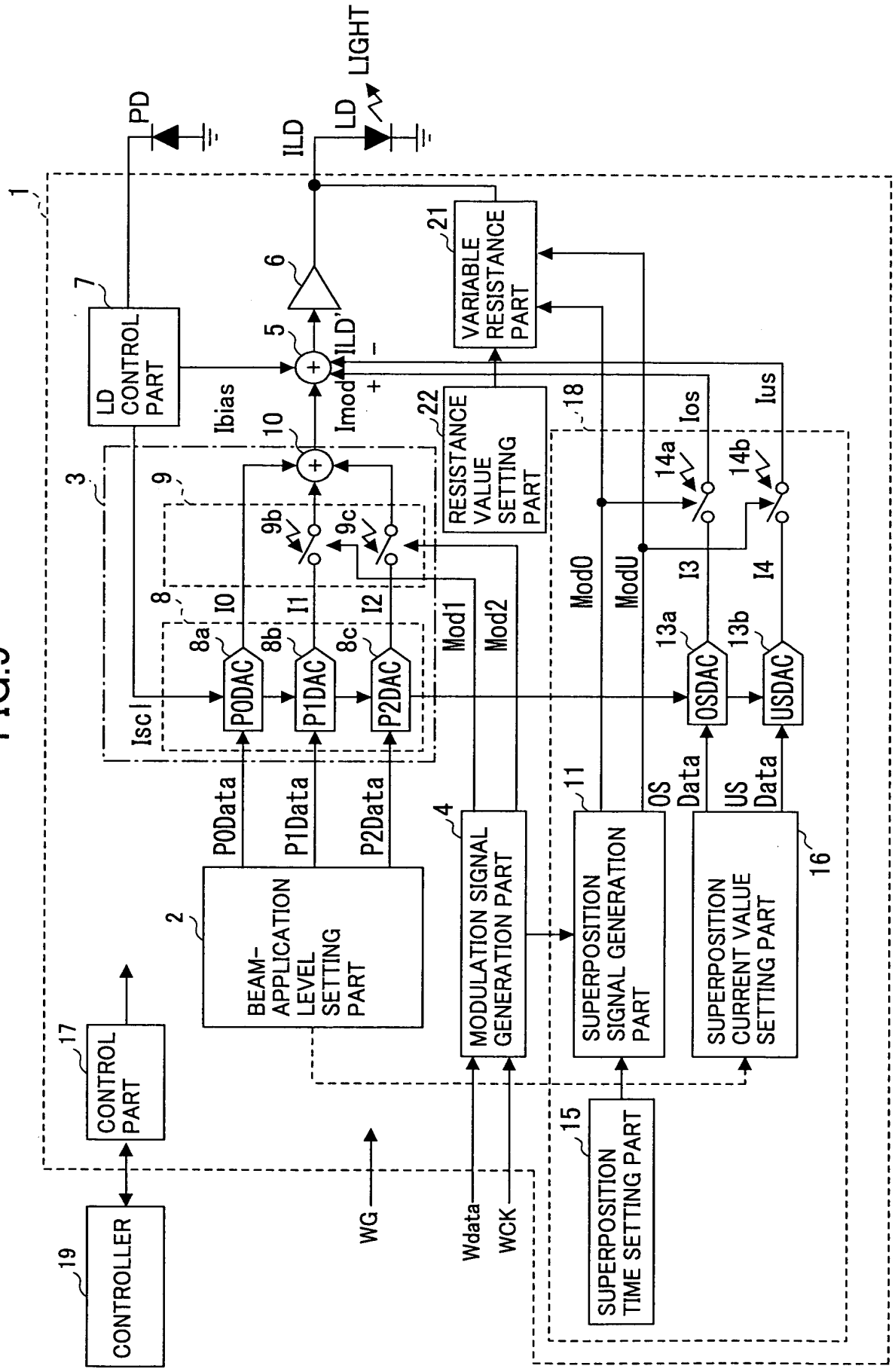

1
PD
ILD
LD
LIGHT
6
5
7
LD CONTROL PART
Ibias
Imod
ILD'
21
VARIABLE RESISTANCE PART
22
RESISTANCE VALUE SETTING PART
10
3
9
9b
9c
8
8a
8b
8c
I0
I1
I2
P0DAC
P1DAC
P2DAC
Isc
Mod1
Mod2
18
Mod0
ModU
Ios
Ius
14a
14b
I3
I4
13a
13b
OSDAC
USDAC
P0Data
P1Data
P2Data
2
BEAM-APPLICATION LEVEL SETTING PART
4
MODULATION SIGNAL GENERATION PART
11
SUPERPOSITION SIGNAL GENERATION PART
OS Data
US Data
16
SUPERPOSITION CURRENT VALUE SETTING PART
17
CONTROL PART
15
SUPERPOSITION TIME SETTING PART
WG
Wdata
WCK
19
CONTROLLER

FIG.10

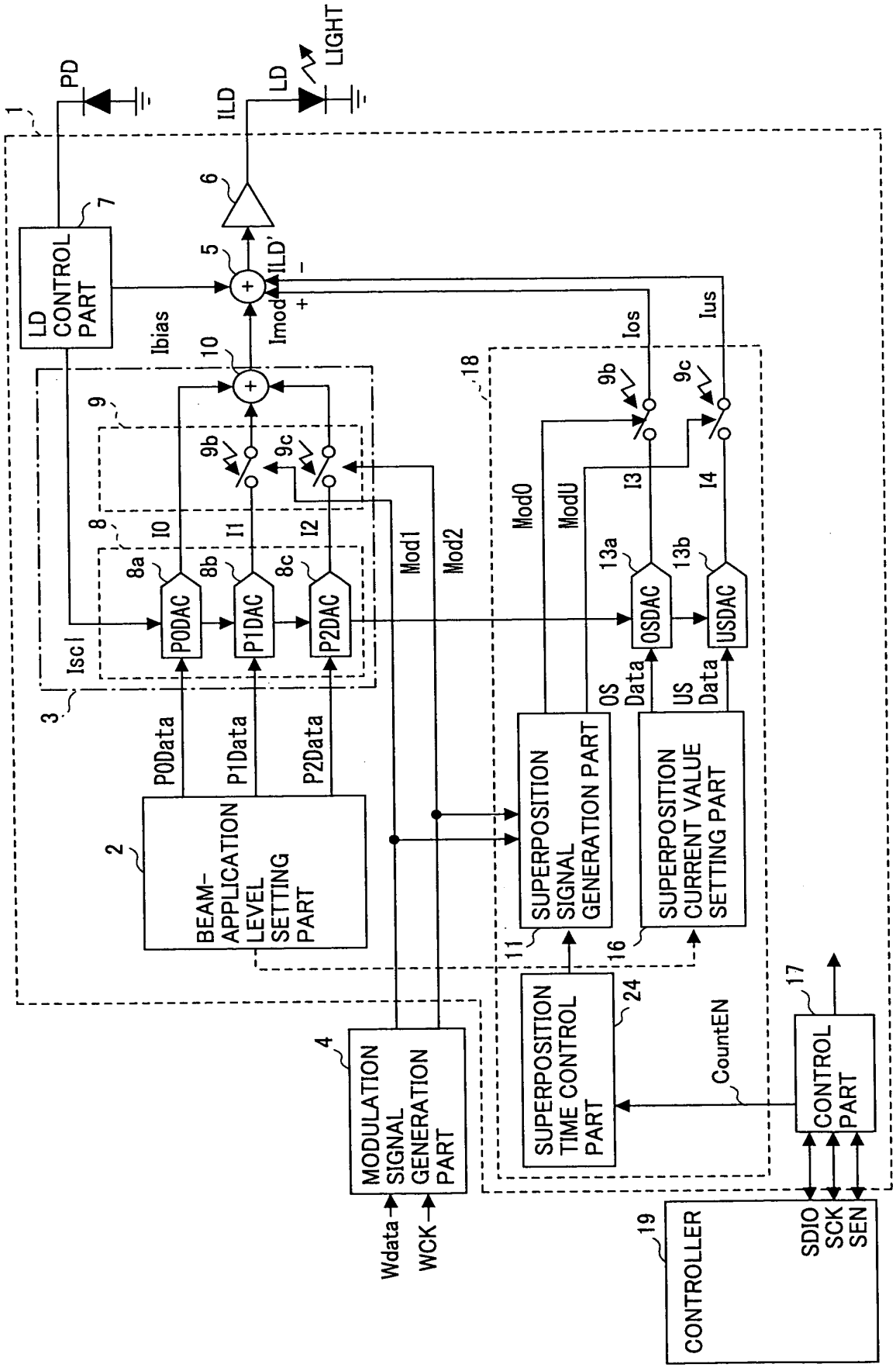
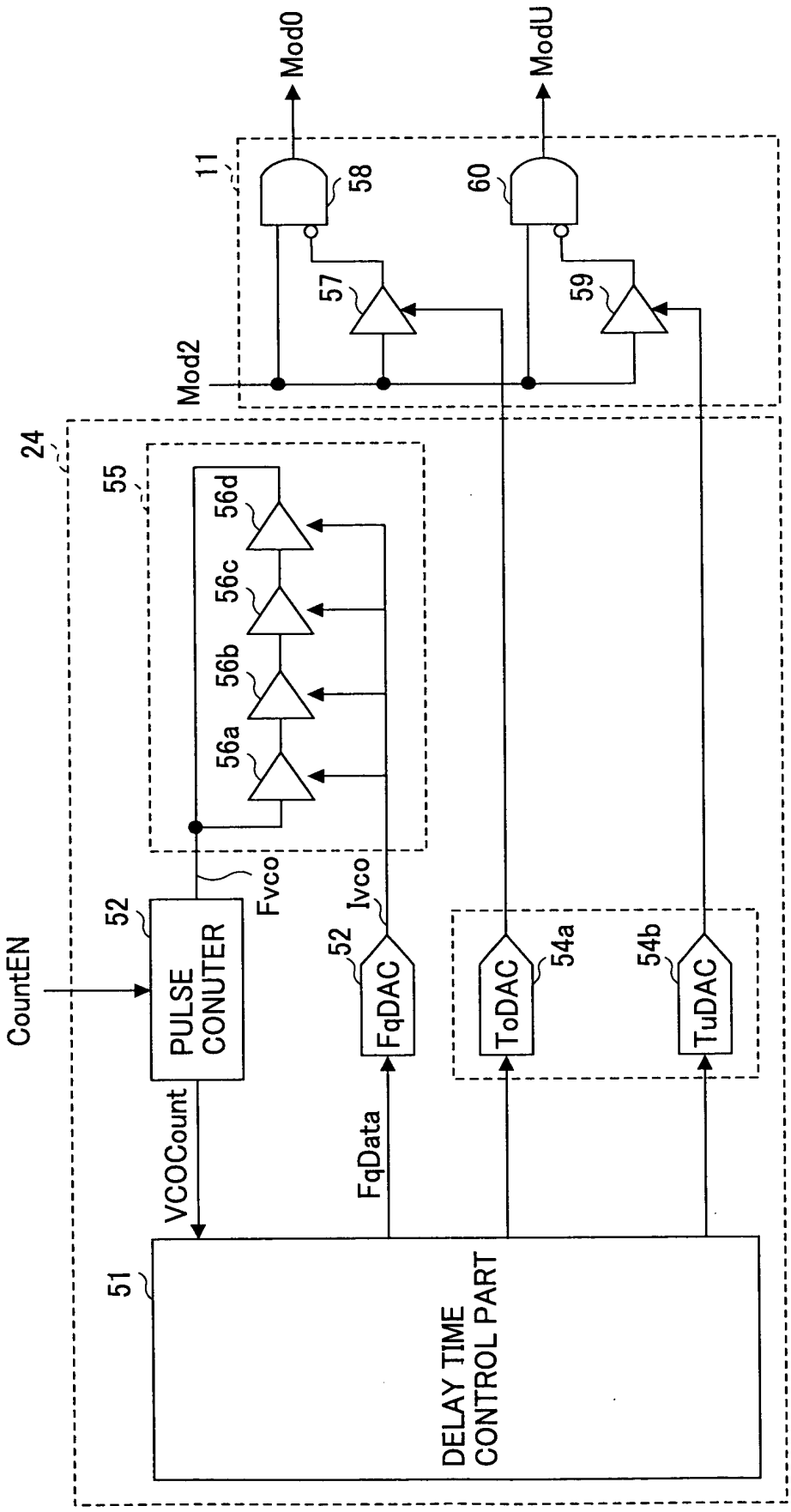

1
PD
ILD
LD
LIGHT
6
7
5
ILD'
LD CONTROL PART
Imod
Ibias
10
9
9b
9c
8
I0
I1
I2
8a
8b
8c
P0DAC
P1DAC
P2DAC
Isc
3
Mod1
Mod2
18
Mod0
ModU
Ios
Ius
I3
I4
13a
13b
OSDAC
USDAC
OS Data
US Data
P0Data
P1Data
P2Data
2
BEAM-APPLICATION LEVEL SETTING PART
SUPERPOSITION SIGNAL GENERATION PART
SUPERPOSITION CURRENT VALUE SETTING PART
11
16
SUPERPOSITION TIME CONTROL PART
24
CountEN
17
CONTROL PART
4
MODULATION SIGNAL GENERATION PART
Wdata
WCK
19
CONTROLLER
SDIO
SCK
SEN

FIG.11


Mod0
ModU
11
58
60
57
59
Mod2
24
55
56d
56c
56b
56a
Fvco
Ivco
52
52
CountEN
PULSE CONUTER
FqDAC
ToDAC
54a
54b
TuDAC
VCOCount
FqData
51
DELAY TIME CONTROL PART

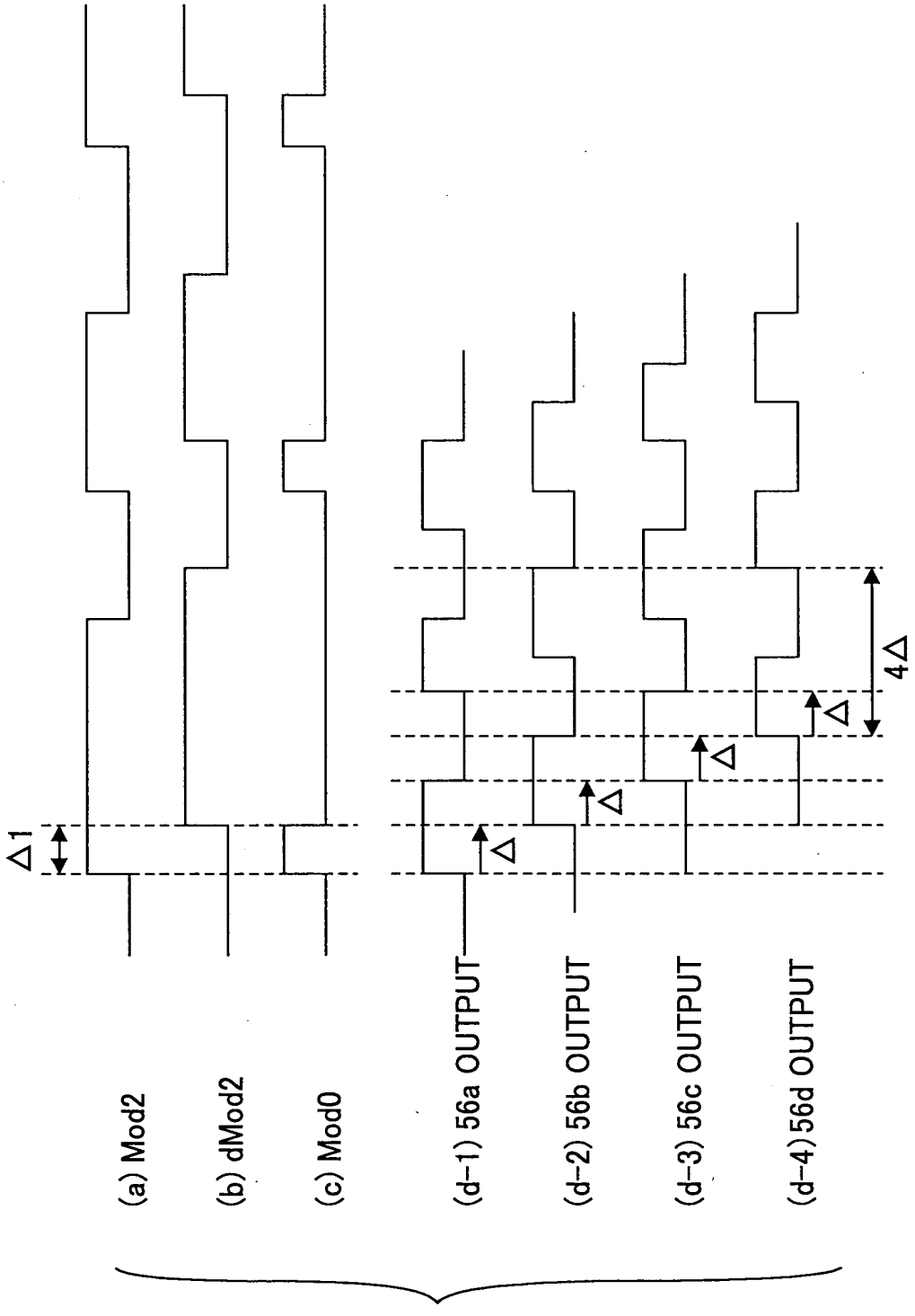
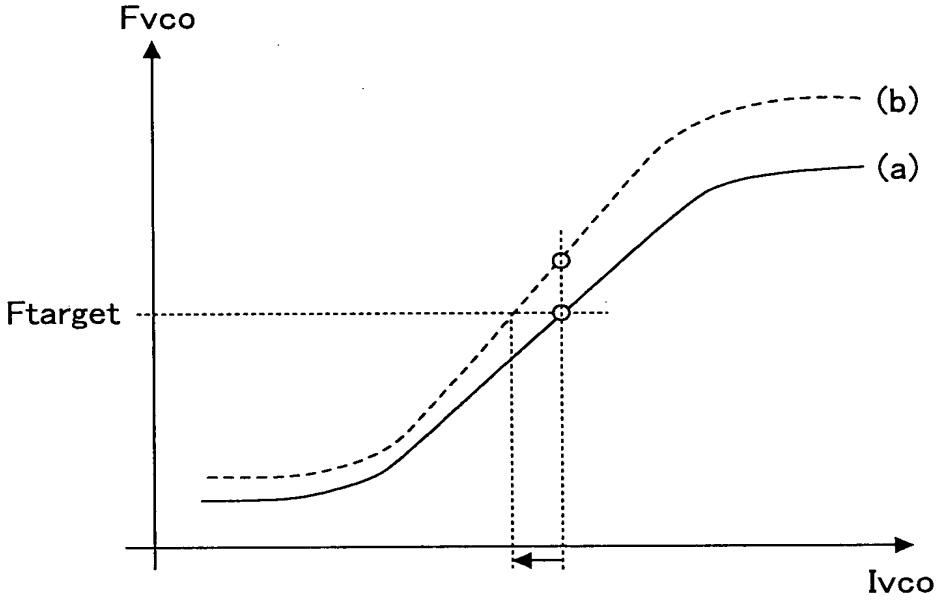

Δ1
Δ
Δ
Δ
Δ
4Δ
(a) Mod2
(b) dMod2
(c) Mod0
(d-1) 56a OUTPUT
(d-2) 56b OUTPUT
(d-3) 56c OUTPUT
(d-4) 56d OUTPUT

FIG.12

FIG.13



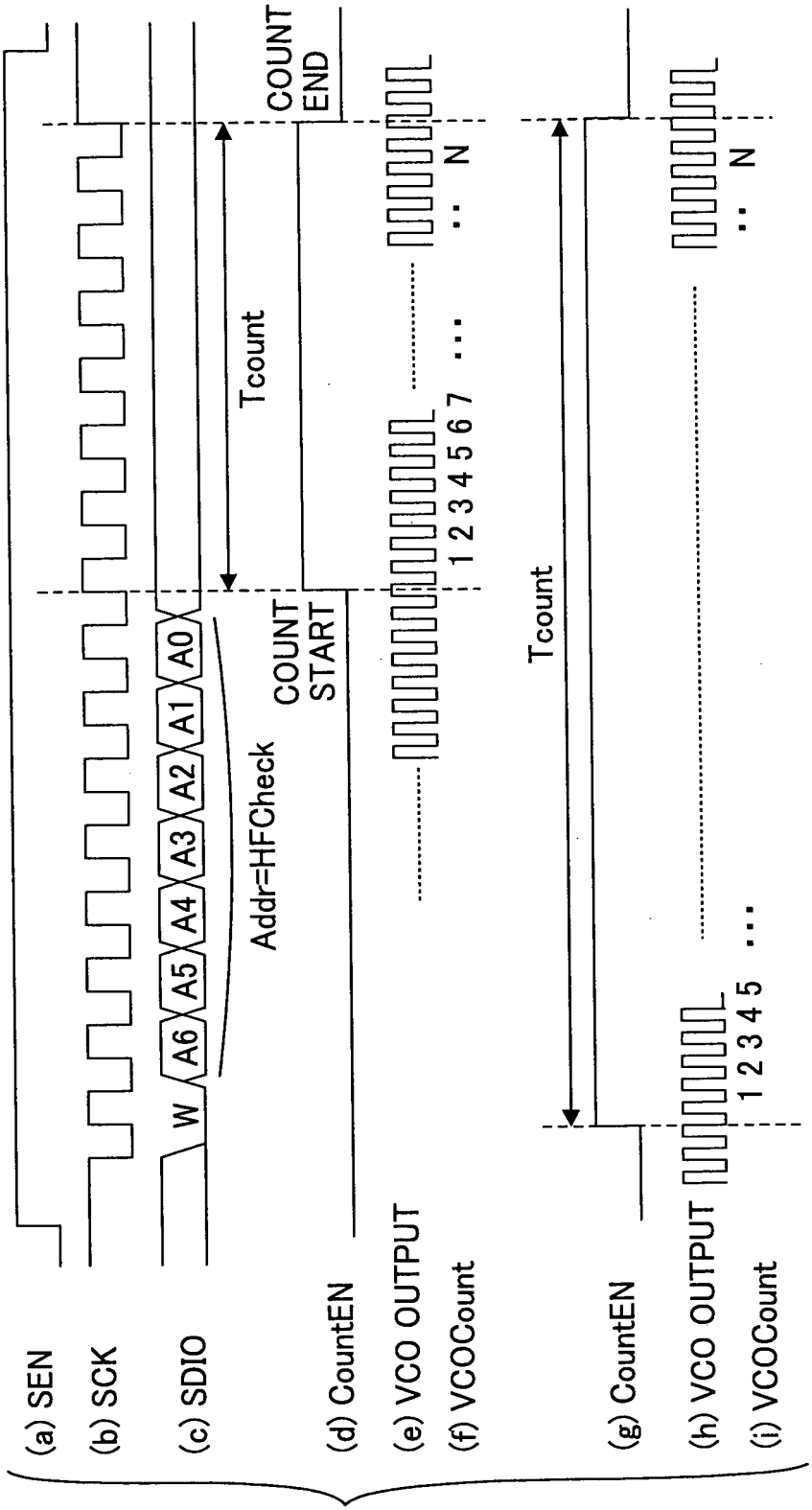

(a) SEN
(b) SCK
(c) SDIO
(d) CountEN
(e) VCO OUTPUT
(f) VCOCount
(g) CountEN
(h) VCO OUTPUT
(i) VCOCount
W
A6
A5
A4
A3
A2
A1
A0
Addr=HFCheck
COUNT START
COUNT END
Tcount
Tcount
1 2 3 4 5 6 7 ... N
1 2 3 4 5 ... N

FIG.14

FIG.15

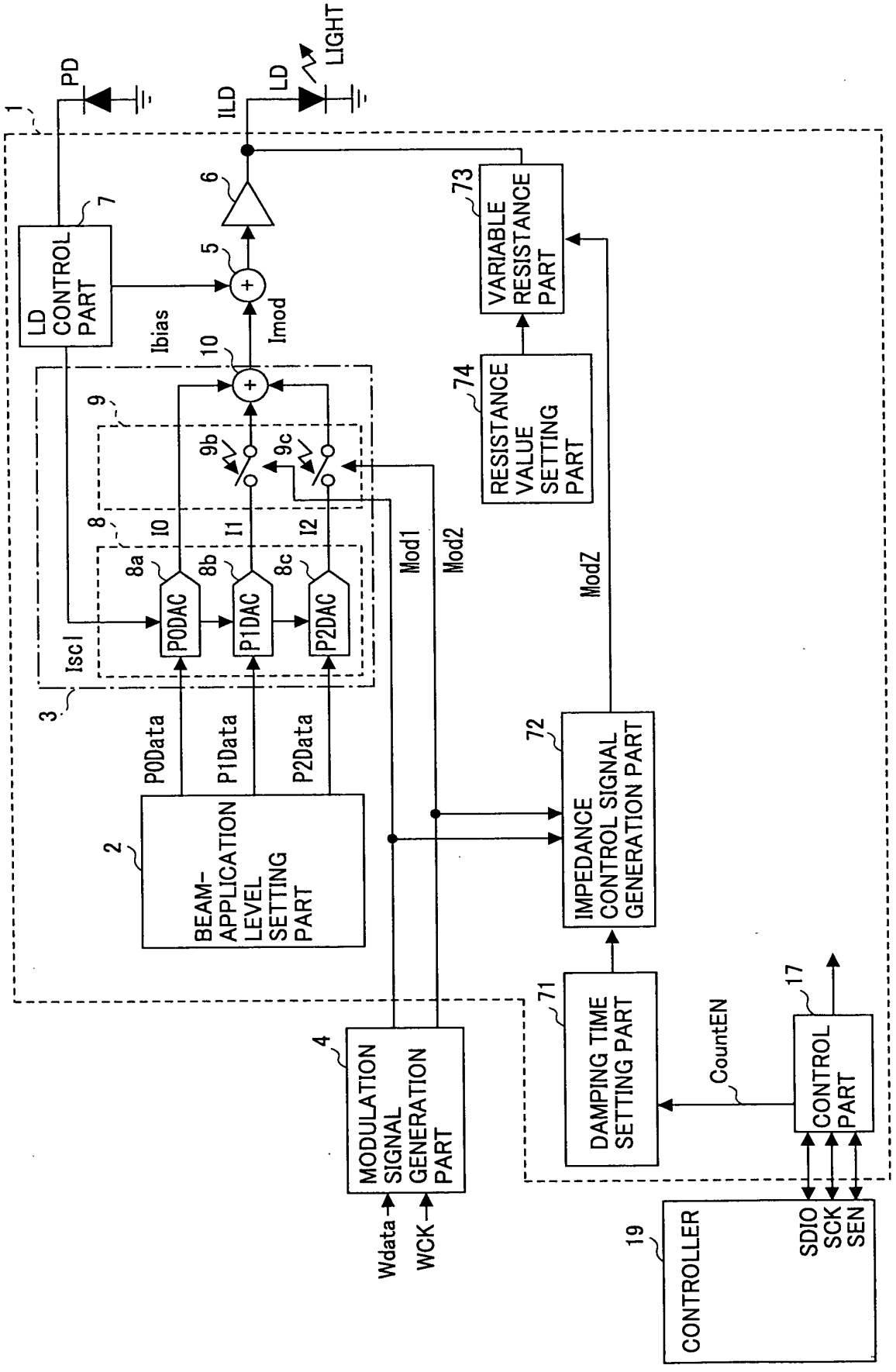

PD
LD
LIGHT
ILD
1
6
7
LD CONTROL PART
5
Ibias
Imod
10
9
9b
9c
8
I0
I1
I2
8a
8b
8c
P0DAC
P1DAC
P2DAC
Isc
3
P0Data
P1Data
P2Data
2
BEAM-APPLICATION LEVEL SETTING PART
Mod1
Mod2
ModZ
73
VARIABLE RESISTANCE PART
74
RESISTANCE VALUE SETTING PART
72
IMPEDANCE CONTROL SIGNAL GENERATION PART
71
DAMPING TIME SETTING PART
CountEN
17
CONTROL PART
4
MODULATION SIGNAL GENERATION PART
Wdata
WCK
19
CONTROLLER
SDIO
SCK
SEN

FIG.16

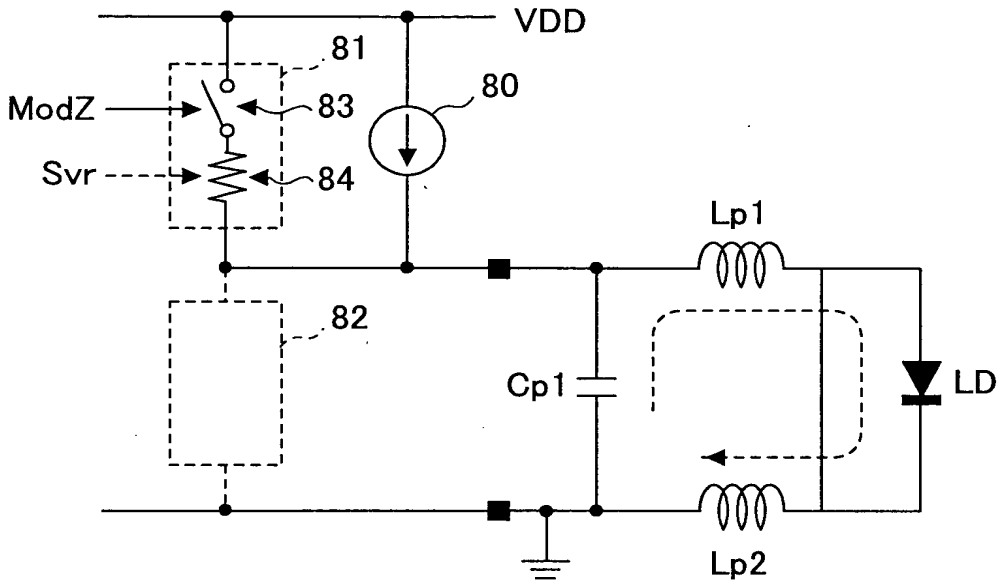

VDD
81
80
ModZ
83
Svr
84
Lp1
82
Cp1
LD
Lp2

FIG.17

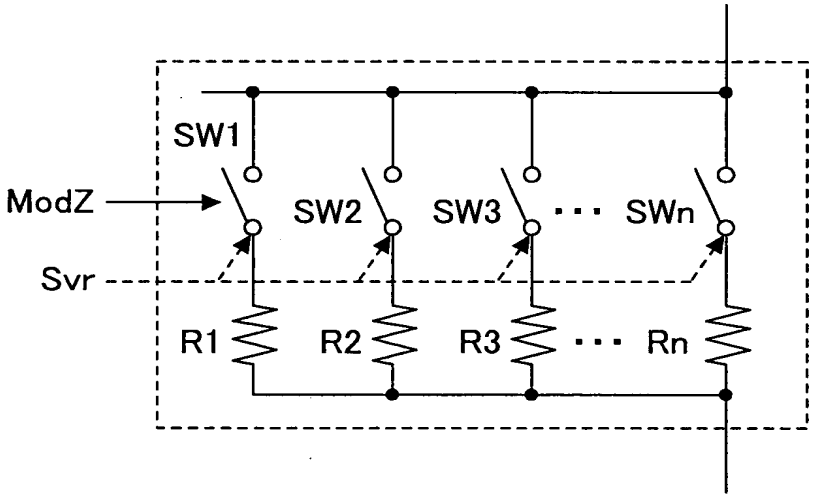

SW1
ModZ
SW2
SW3
SWn
Svr
R1
R2
R3
Rn

FIG.18

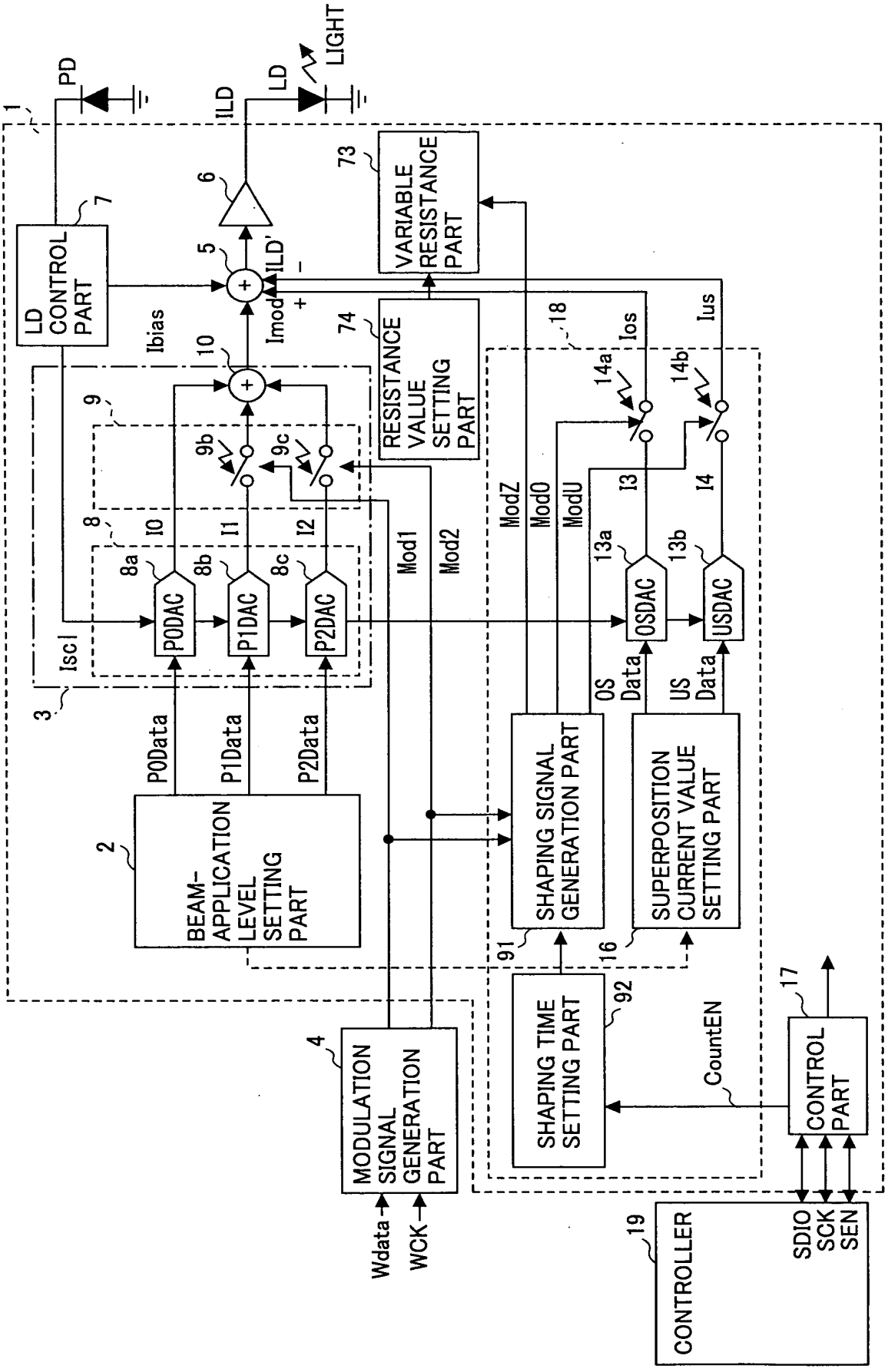

PD
LD
LIGHT
ILD
ILD'
LD CONTROL PART
VARIABLE RESISTANCE PART
RESISTANCE VALUE SETTING PART
Ibias
Imod
Isc1
P0DAC
P1DAC
P2DAC
OSDAC
USDAC
Mod1
Mod2
ModZ
ModO
ModU
Ios
Ius
I0
I1
I2
I3
I4
P0Data
P1Data
P2Data
OS Data
US Data
BEAM-APPLICATION LEVEL SETTING PART
SHAPING SIGNAL GENERATION PART
SUPERPOSITION CURRENT VALUE SETTING PART
SHAPING TIME SETTING PART
MODULATION SIGNAL GENERATION PART
CONTROL PART
CountEN
Wdata
WCK
CONTROLLER
SDIO
SCK
SEN

FIG.19

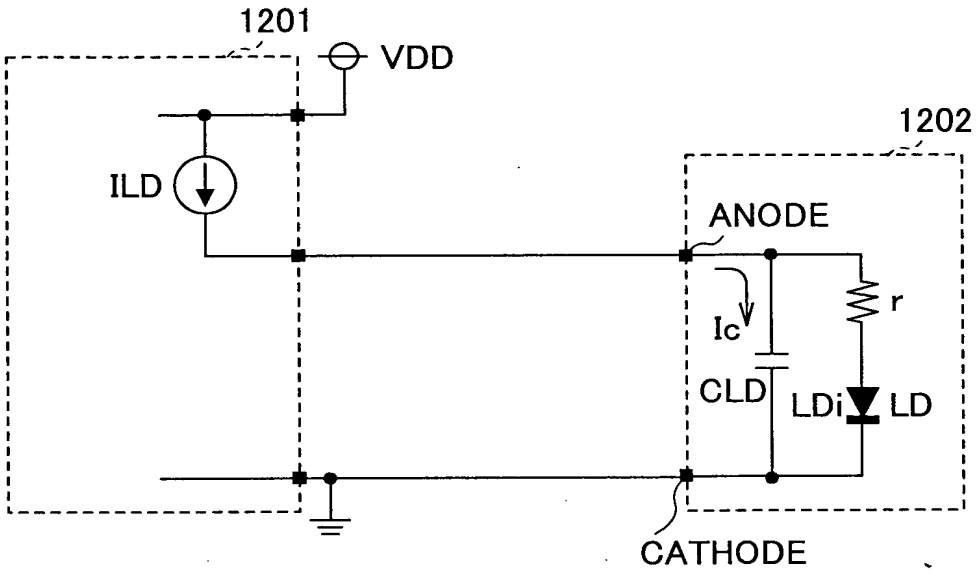


FIG.20

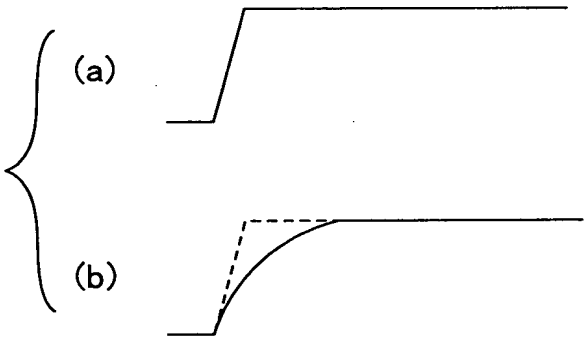
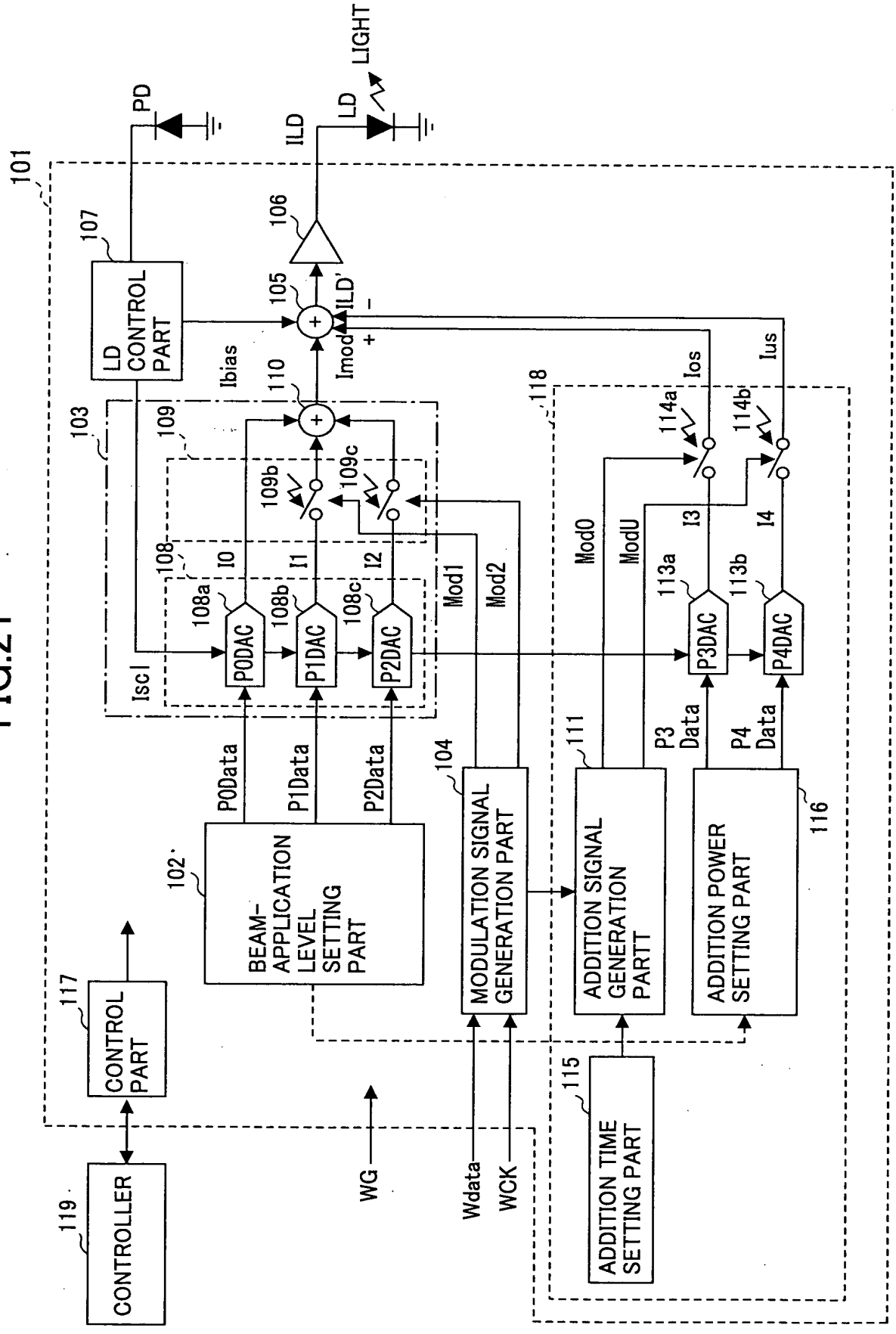


FIG.21


LIGHT
PD
LD
ILD
101
107
LD CONTROL PART
106
105
ILD'
Ibias
Imod
Ios
Ius
110
103
109
109b
109c
108
I0
I1
I2
108a
108b
108c
P0DAC
P1DAC
P2DAC
Isc
Mod1
Mod2
118
114a
114b
Mod0
ModU
I3
I4
113a
113b
P3DAC
P4DAC
P0Data
P1Data
P2Data
P3 Data
P4 Data
104
111
116
102
BEAM-APPLICATION LEVEL SETTING PART
MODULATION SIGNAL GENERATION PART
ADDITION SIGNAL GENERATION PARTT
ADDITION POWER SETTING PART
117
CONTROL PART
115
ADDITION TIME SETTING PART
WG
Wdata
WCK
119
CONTROLLER

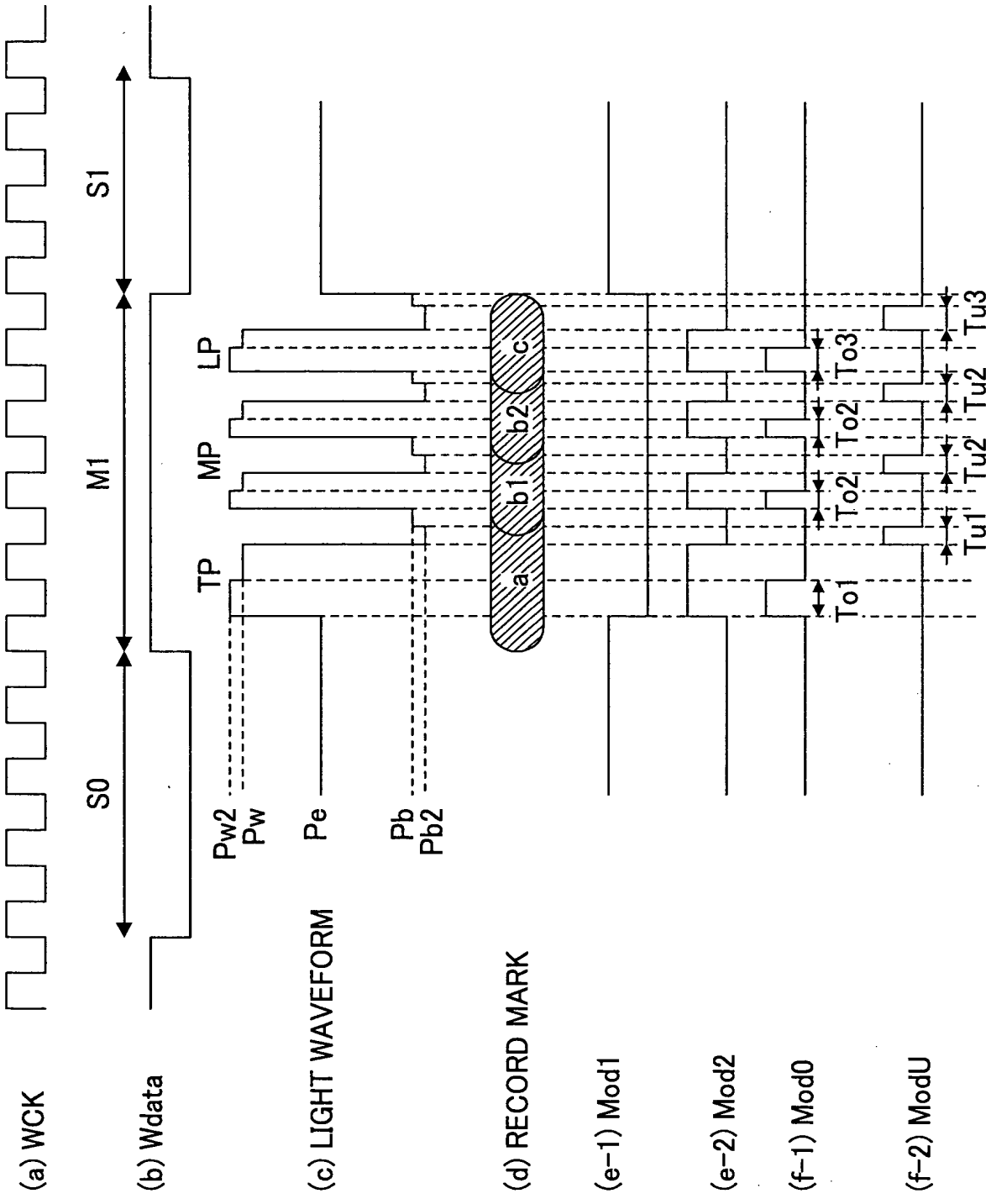

(a) WCK
(b) Wdata
(c) LIGHT WAVEFORM
(d) RECORD MARK
(e-1) Mod1
(e-2) Mod2
(f-1) Mod0
(f-2) ModU
S0
M1
S1
TP
MP
LP
Pw2
Pw
Pe
Pb
Pb2
a
b1
b2
c
To1
To2
To2
To2
To3
Tu1
Tu2
Tu2
Tu3

FIG.22

FIG.23

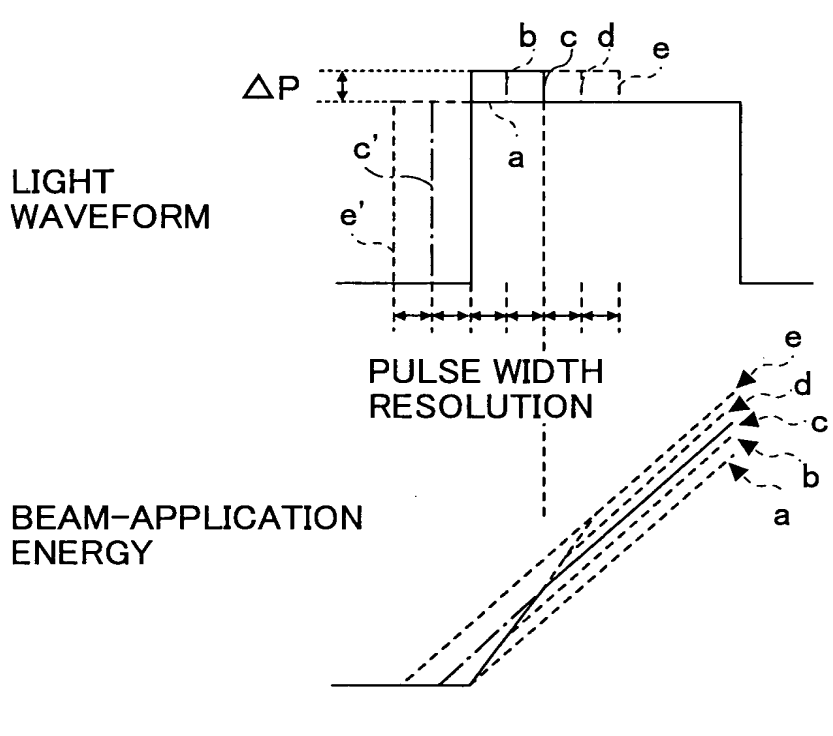
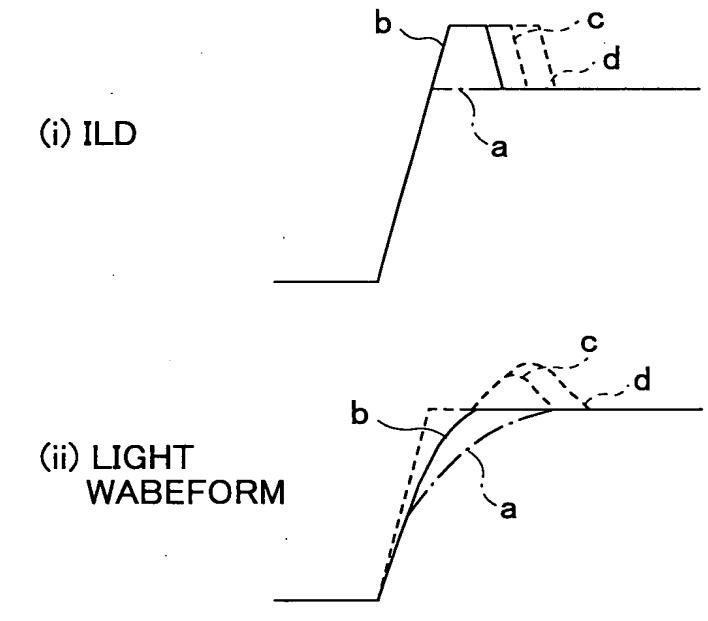

LIGHT WAVEFORM
ΔP
b c d e
a
c'
e'
PULSE WIDTH RESOLUTION
BEAM-APPLICATION ENERGY
e
d
c
b
a

FIG.24


(i) ILD
b
c
d
a
(ii) LIGHT WABEFORM
c
d
b
a